Evaluation of Hydrologic Effects on Native Rio Grande Flows by Operation of Buckman Water Diversion Project: Response to USFWS Issues Raised Relative to Possible Impacts on Rio Grande Silvery Minnow (4th DRAFT)

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Background

The Draft Environmental Impact Statement (DEIS) for the Buckman Direct Diversion project (BDD) was developed by TetraTech under contract to the U. S. Forest Service (USFS) and Bureau of Land Management (BLM) in late 2004. Subsequently, comments on the DEIS received from the U. S. Fish and Wildlife Service (FWS) raised issues about possible effects of BDD operation on downstream river flows available for the Rio Grande silvery minnow (minnow). Because the minnow does not exist in the reach between Buckman and Cochiti Dam, the primary concern of the FWS is with the reach below Cochiti, through Albuquerque, and downstream to the San Acacia-San Marcial area -- the reach which has been designated as critical habitat for the minnow by FWS.

See Attachment A for a schematic of the Rio Grande system, including major dams, inflow and return flow points, and irrigation diversion works below Otowi.

This memo is intended to summarize pertinent background information on the hydrologic situation regarding Rio Grande flows and the minnow; and based on several conservative assumptions and calculations, develop preliminary conclusions regarding the possible effects of the operation of the BDD on downstream flows, and propose an approach by which the proponents of the BDD could work with FWS and others during pending low flow periods so as not to interfere with the ability to manage downstream flows for the benefit of the minnow.

Existing River Management Provisions Related to the Minnow

The FWS has recently reached agreements with the City of Albuquerque (Albuquerque), the U.S. Army Corps of Engineers (Corps), the U. S. Bureau of Reclamation (Reclamation) and the Middle Rio Grande Conservancy District (MRGCD) regarding management of Rio Grande flows during dry periods. Provisions of these agreements are partially summarized in Attachment B.

The *Biological Opinion* of 2003 (BO), prepared by the FWS, Reclamation, and others regarding flows at and below Albuquerque, allows for the reach of the river below Isleta Pueblo to go dry during specified drought conditions with the recession managed to allow minnow recovery from pools and other measures as necessary. The BO establishes a goal of

100 cfs at the Central gage in Albuquerque, a commitment by MRGCD to keep water in the river between San Acacia and San Marcial to the extent possible. Also, in cases where "minnow water" is being specifically released by Reclamation or others from Cochiti, to pass such releases through the Isleta Diversion with half of the quantity of such releases also passed through the San Acacia diversion.

Another Agreement**, *the Emergency Drought Water Management Agreement*** between the MRGCD, FWS, the Bureau of Indian Affairs (BIA), and the Corps is intended, to the extent possible, to maximize the amount of water in the Rio Grande at Albuquerque (again with a goal of 100 cfs at the Central gage) and several downstream locations during low flow periods for the benefit of the minnow. Essentially, this Agreement calls for the MRGCD to ensure to the extent practicable that MRG project facilities are made available to deliver minnow water consistent with the requirements of the *2003 BO*.

The Agreement with Albuquerque arising from FWS Section 7 consultation on the *Drinking Water Project EIS* (2003) requires operation of Albuquerque's new surface diversion facility near Alameda Bridge such that diversions are curtailed and eventually ceased during low flow periods so as to keep the river 'wet' from the diversion point just below the Corrales Riverside Drain (about river mile 192) to the wastewater outfall return flow point (river mile 177) (see map in Attachment A). The intent is to not allow the operation of the Albuquerque diversion (which diverts both SJC water and native water) to cause the flow at the Central gage to fall below 105 cfs. A description and schematic diagram of the Albuquerque diversion curtailment plan is provided in Attachment C.

It should be noted that the OSE conditions of approval for the Albuquerque diversion also call for releases of large additional quantities of SJC water from Abiquiu Reservoir (more than 100,000 ac-ft in addition to that released for direct diversion from the river) during the first several decades of operation of the Drinking Water Project. These releases are intended to compensate for a water rights/balance shortage that would otherwise occur do to the lingering effects of Albuquerque's historic pumping on river flows. That is, even with the much reduced level of groundwater pumping at Albuquerque there will a "hangover effect" from past pumping that must be mitigated. The release of extra SJC water should serve to help maintain the 105 cfs at the Central gage.

Potential Effect of BDD Operation on Availability of River Water for the Minnow

The concerns raised by FWS regarding the BDD apparently relate to native water only, since any SJC water involved is considered as imported water; and, thus, "additive" to native flows. By Compact agreements with Colorado and Texas, SJC water must be consumptively used in New Mexico, with any fish and wildlife benefits considered as incidental.

Historically, under the procedures and regulations of the NM State Engineer (OSE), native water rights can be transferred from one location within a basin to another if such a change can be made without detriment to existing water rights, is not contrary to conservation of water within the state and is not detrimental to the public welfare of the state as determined by the State Engineer. NMSA § 72-5-23.

As mentioned above, the questions raised by FWS relative to the minnow focus on the potential effect of the diversion of native water at the BDD on river flows available for the minnow below Cochiti; and particularly on the 105 cfs target flow at the Central gage.

Several of the provisions mentioned above and further detailed in Attachment B illustrate the plans already in place to ensure meeting the 105 cfs target.

Water Rights and Mix of Native and SJC Water Diverted at the BDD

The proposed BDD project involves the diversion of imported SJC water by the City of Santa Fe (City) and Santa Fe County (County) and the diversion of native Rio Grande water by the County and Las Campanas. As summarized in Table 1 (adapted from the DEIS, p. 140), a total of up to 8,730 acre-feet/year (ac-ft/yr) could be diverted during a drought year, comprised of 5,605 ac-ft/yr of SJC water and potentially up to 3,125 ac-ft/yr (see comments below) of native water. Table 1 indicates a maximum expected monthly diversion rate at BDD [28.2 cubic feet per second (cfs)] in June under the very conservative assumption of the non-availability of a surface supply from Santa Fe Canyon or from the Buckman wellfield – that is, under an assumption that the BDD would provide essentially the entire municipal water supply to the Santa Fe Region.

Regarding operation of the BDD, the DEIS, p. 141, states that:

"The Buckman water diversion structure would not be operable at full capacity (diversion of 28 cfs) at river flow rates of 200cfs or below and would be inoperable during very low river flow circumstances of 150 cfs or less." ….

"…the Buckman Project's commitment to use native flows during nonpeak times and the design of the Buckman water diversion structure to not allow water diversion at flows of 150 cfs or less coupled with the regional mitigation measures would serve to avoid an adverse effect to the silvery minnow population."

The DEIS (p. 139) also states that approximately 1,925 ac-ft/yr of native water (rather than 3,125 ac-ft/yr) could be diverted at Buckman under the assumption that Las Campanas would continue to use its leased 1,200 ac-ft/yr SJC water through 2011. Las Campanas already has 600 ac-ft/yr of native water transferred to the Buckman area which has been used to offset the effects of groundwater pumping on river flows since prior to the 2003 Biological Opinion.

During preparation of the DEIS, and not included in the document at present are several other developments relative to water rights, including:

- The County has approximately 941 ac-ft/yr of native water in the process of transfer to Buckman, and would presumably obtain an additional 181 ac-ft/yr of additional native (or SJC) rights to meet their projected demand of 1,700 ac-ft/yr (Doug Sayre, oral communication, August 24, 2005).
- Las Campanas reached agreement with the City for use of treated effluent on their golf courses in late 2003. The Agreement allows for use of up to 430 ac-ft/yr of effluent through the year 2027. This, in effect, reduces the maximum diversion of native water at BDD by Las Campanas from 1,800 to 1,370 ac-ft/yr, at least through 2027.

The City has signed a 50-year lease with the Jicarilla Apache Tribe for 3000 ac-ft/yr of SJC water intended to offset past and present effects of Buckman well pumping on Rio Grande

Table 1. Estimated 2010 Maximum Annual and 2010 Peak-Day Drought Year Demands for the Buckman Diversion Project

Water User	Annual Demand (ac-ft/yr)	Peak Day Demand (mgd)	Peak Day Demand (cfs)
Santa Fe City/County	6,930	15.0	23.2
Las Campanas	1,800	3.2	5.0
Total	8,730	18.2	28.2

Notes: mgd = million gallons per day; cfs = cubic feet per second.

Month	Portion of Peak-Day Demand in Stated Month[a]	Peak-Day Demand[b] (mgd)	Peak-Day Demand[b] (cfs)
January	0.40	7.3	11.3
February	0.45	8.2	12.7
March	0.50	9.1	14.1
April	0.65	11.8	18.2
May	0.85	15.4	23.8
June	1.00	18.2	28.2
July	0.93	16.9	26.1
August	0.85	15.4	23.8
September	0.80	14.6	22.6
October	0.70	12.7	19.6
November	0.50	9.1	14.1
December	0.40	7.3	11.3

[a] Estimated from recent records provided by City of Santa Fe.

[b] It is unlikely that peak-day demands listed would occur in consecutive months. Values presented in this table are estimates of the highest possible use of the diversion in any given month under an assumption that the BDD had to provide the entire water supply to the Santa Fe region.

flows. Las Campanas and the County are involved in discussions with various parties for SJC water that could be diverted at BDD in lieu of native water.

In summary, there are many possible sources of water supply available to the BDD proponents, and agreements as to how to use and/or share the various sources are under active discussion at present. Thus, there is uncertainty as to the future proportions and timing of the amounts of SJC and native water diverted at the BDD. The DEIS does not specify the timing or portions of SJC and/or native water diverted. Moreover, the final amounts of SJC and native water actually diverted at BDD are subject to permit approvals through the OSE that will initiated in the future.

For purposes of this memorandum, we assume that a maximum of 2,525 ac-ft/yr of native water could be diverted at BDD. This figure was developed as follows:

1. Maximum annual diversion = 8,730 ac-ft;
2. SJC portion of diversion = 5,605 ac-ft;
3. Native previously transferred to Buckman and currently in use for offsets = 600 ac-ft;
4. Maximum native to be diverted at BDD under the EIS = 8,730 – 5,605 - 600 = 2,525 ac-ft.

In reality, it is highly unlikely that 2,525 ac-ft/yr of native will ever be diverted at the BDD – more likely about half this quantity will be involved. However, in the interests of being conservative regarding possible effects on the minnow, 2,525 ac-ft will be used as the operable number below.

Evaluation of Effects of BDD on Native Flows

Diversion Rates at BDD

Assuming that 2,525 ac-ft/yr (3.49 cfs on average) of native water was diverted at BDD with all those rights being historic consumptive use transferred from the Socorro area. On an average basis, this means that the flow in the Rio Grande between the BDD and Socorro (or San Acacia diversion dam) would be reduced by a maximum of 3.49 cfs. The "carry water" historically in the river between the two points would still be in the river since only the historic consumptive use at Socorro will be transferred to BDD.

Another point relative to the transfer of irrigation water from Socorro to Buckman is that the length of the irrigation season involves only eight months, March through October. Thus, the average irrigation season consumptive use before transfer to BDD was about 5.2 cfs (12/8 x 3.48) as compared to a maximum BDD diversion (consumptive use) of 3.48 cfs over twelve months.

The diversion of native water at BDD will vary by month depending on Las Campanas and County demands. A review of Albuquerque and Santa Fe water demand data was used to estimate the monthly distribution of likely demands and is summarized in Table 2. The estimated mean monthly diversion varies from a low of 2.06 cfs in winter to 5.53 to 5.76 cfs in June-July.

Demand at BDD	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
Monthly Distribution	5.0%	5.0%	6.0%	7.0%	10.0%	13.0%	14.0%	11.0%	10.0%	8.0%	6.0%	5.0%	100.0%
ac-ft	126	126	152	177	253	328	354	278	253	202	152	126	2,525
cfs	2.06	2.28	2.47	2.98	4.11	5.53	5.76	4.53	4.25	3.29	2.55	2.06	3.49

Table 2. Assumed Monthly Distribution of Demand for Native Water At Buckman Direct Diversion Project

Flow reductions of 3.49 cfs on an average daily basis, or up to 5.76 cfs on a peak monthly basis, are not within the measurement error of either the USGS gages at Otowi and Central (Albuquerque), whose records are rated as "fair"– i.e., within only 15% of actual discharge. The USGS rating system for gage accuracy has four categories – "excellent, good, fair, and poor." Excellent means that about 95 percent of the daily discharges are within 5 percent of the true value; "good" within 10 percent; and "fair" within 15 percent. Records that do not meet the criteria mentioned are rated "poor." Different accuracies may be attributed to

different parts of a given record. The probable error in a monthly or annual mean discharge depends more on the distribution of the daily errors between the limits than it does on the limits themselves. For this reason, monthly and annual records are more accurate than most daily records.

Estimated Frequency of Low Flows at BDD

To further examine the potential effect of native water diversions at BDD, the 1971-2004 record of low-flows at the Otowi gage was evaluated. Based on the hydrologic effects evaluation done for the Albuquerque Drinking Water Project EIS, this 1971-2004 record is representative in general of the > 100 year period of gaging record at Otowi, incorporates the release of SJC water starting in 1971, and was within the period of operation of upstream reservoirs at Heron and Abiquiu.

A summary of the frequencies of various consecutive day low flows is provided in Figure 1. The evaluation is based on the 1971-2004 period of USGS gaging records and standard frequency analysis techniques (USGS – *Low Flow Investigations by H. C. Riggs, Chapter B1, Techniques of Water-Resources Investigation of the US Geological Survey, 1972).* Examination of the curves in Figure 1 suggests that 7-, 14-, and 30-day flows of about 275, 300, and 350 cfs would occur about once every 10 years (1-day lows are considered too erratic to use as an index). An unknown quantity of SJC water is included within the various frequency curves depicted in Figure 1 – i. e., the amounts of native water flowing at Otowi for a given frequency could be considerably less than depicted by Figure 1. SJC water at Otowi has historically not been accounted for on a daily basis.

The flow record was further examined to determine the likely months of occurrences of < 350 cfs flows at Otowi. Results are presented in Figure 2. Approximately 60% of the lowest flows occurred in August-October (50% in September and October), with only a small number of lowest flows in July, and none in June. The remainder of the lowest flows at Otowi occurred in late fall or winter months which are of little consequence to the minnow, because there is relatively little flow depletion in the Rio Grande between Otowi and Albuquerque during these months. The river typically remains 'wet' from Otowi to San Marcial during late fall and winter.

Review of Table 2 and Figure 3 suggests that the likely occurrence of low flows at the BDD site (most likely September-October) would occur at a time when diversions of native water at BDD were at 60%-75% of the peak June-July months – 3.29 to 4.25 cfs vs. 5.53 to 5.76 cfs.

Figure 2. Frequency curves of annual lowest mean discharge for consecutive days at Otowi gage on Rio Grande, 1971-2004

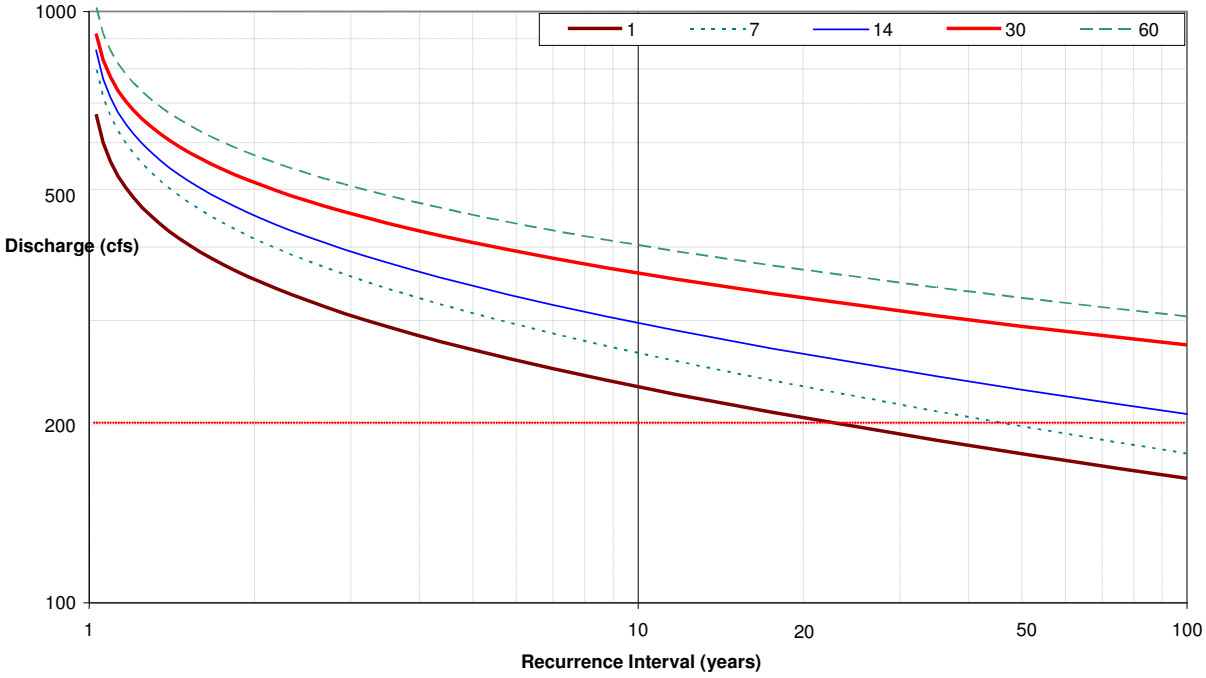
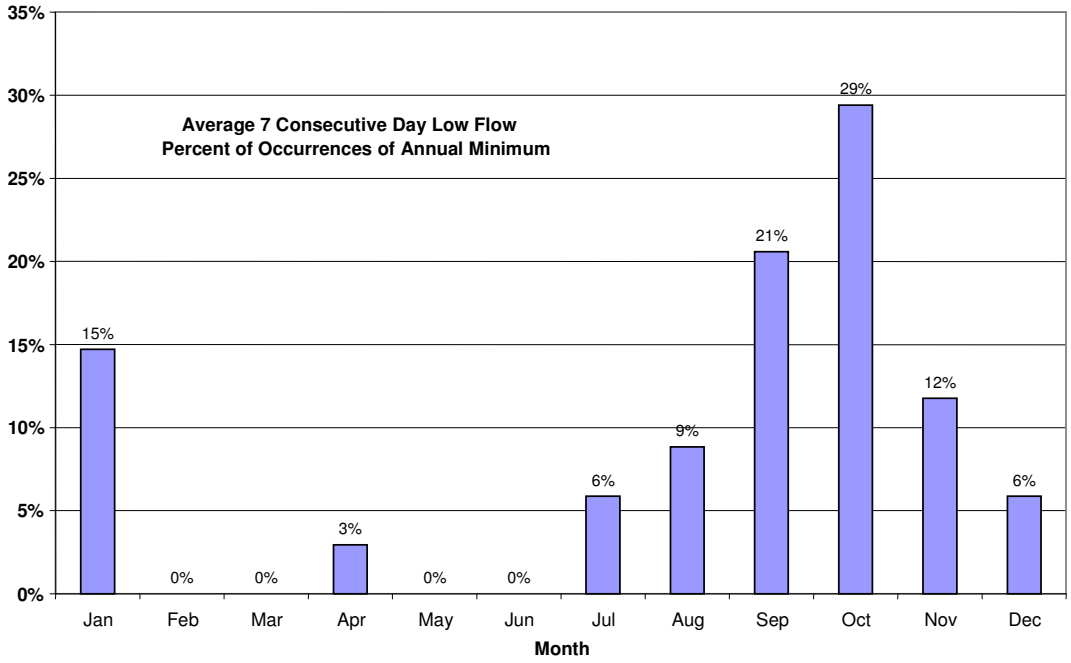


Figure 2. Recurrence of 7-Day Low Flow by Month, 1971-2004



Relationship of Low Flows at BDD (Otowi Gage) to Central Gage

The work done to establish the 105 cfs target for native flow at the Albuquerque gage (and the threshold for curtailment of the Albuquerque diversion) was based on the approximate recurrence of a monthly low flow (and curtailment of the Albuquerque diversion) about once every 8-12 years. This was developed for a 60-year future simulation from a combined groundwater-surface water model known as the AWRMS Model that accounted for future reductions in groundwater pumping, extra releases of SJC water during initial decades of the project (see subsequent discussion), and simulated operation of the diversion system at Albuquerque.

The simulated 8-12 year monthly value of 105 cfs at Albuquerque could roughly be considered to correspond to an 8-12 year, 30-day low flow at Otowi (indicated in Figure 1) of about 300cfs.

As another way of examining the relationship between flows at Otowi and flows at Central, an evaluation was undertaken of concurrent periods of low flow (typically 3-10 day periods) at the two gages during the months of August, September, and October over the 1985-2004 period. We reasoned that as the most recent period, the 1985-2004 record may be most reflective of the way the river will be managed in the future under the BO and other agreements to maintain the 105 cfs target flow at the Central gage.

Results are summarized in Table 3 and suggest that a flow of about 300-325 cfs at Otowi should be adequate to allow 105 cfs to be maintained at Albuquerque (i.e., Central gage) with some margin for error; particularly with the agreements in place with Albuquerque and MRGCD for operational management during low flow periods.

Month	Flow in cfs		
	Otowi	Albuq	Difference
August	335	325	10
September	328	142	187
October	324	258	65

Table 3. Summary of concurrent flows of <350cfs at Otowi and Albuquerque
(average of <350 cfs daily flow periods, 1985-2004)

Potential Effect of BDD Operation on River Hydraulics and Channel Geometry

An evaluation was conducted as part of both the BDD DEIS and Albuquerque Drinking Water Project EIS regarding the possible effects of the diversions on channel geometry and hydraulics in the Albuquerque and Buckman reaches. That work indicated that the effects of a +/- 65 cfs change in flow at Albuquerque during low flow periods would cause water depths to change by only a few tenths of a foot above to below the diversion; and virtually no change in flow velocities. The +/- 5 cfs differences in flow potentially caused by operation of the BDD would cause no measurable changes in flow depths or velocities, either at Albuquerque or downstream of the BDD.

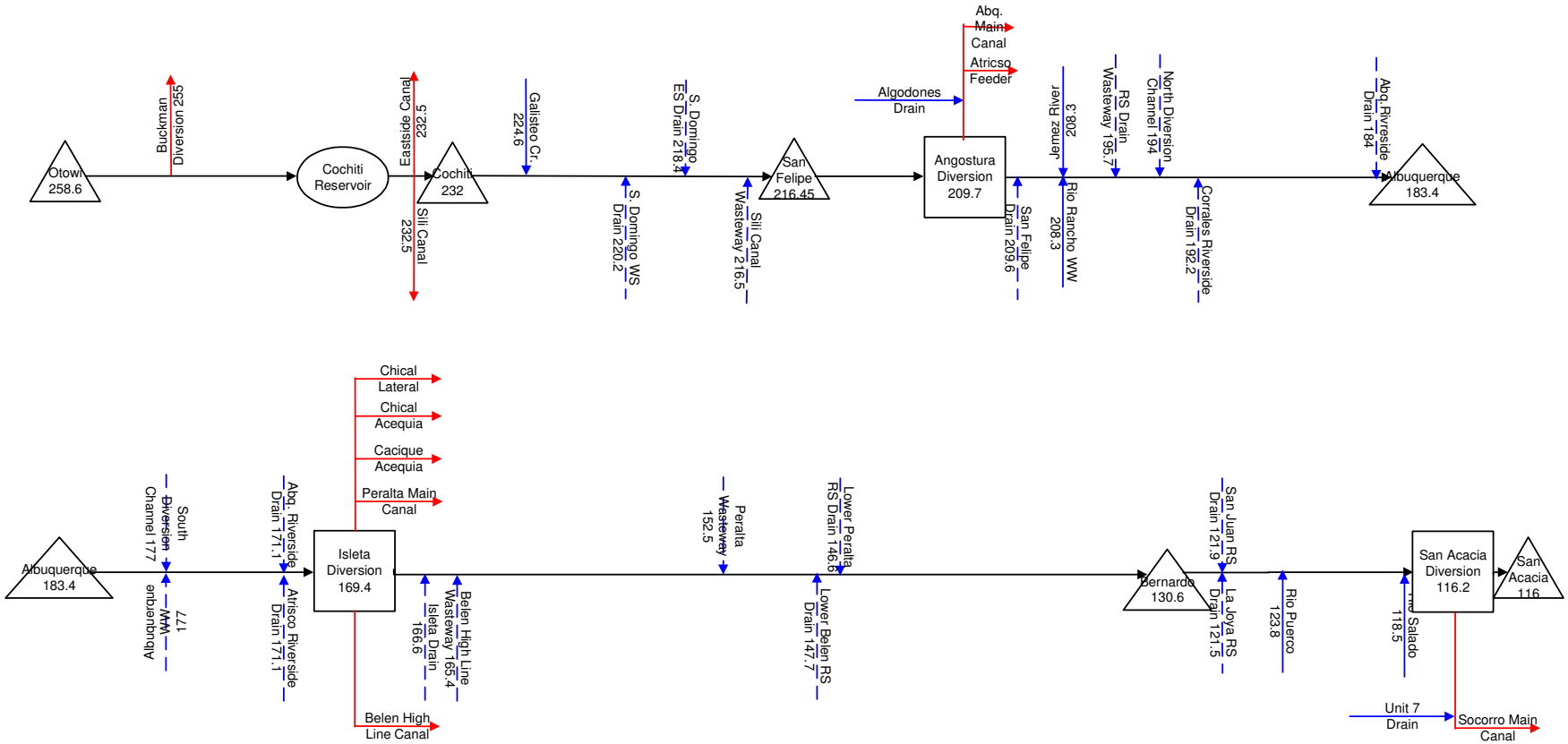
Conclusions and Recommendations

- The concerns raised by FWS about possible effects of the BDD operation on river flows available for the minnow primarily relate to the diversion of native water that has been transferred from downriver to the Buckman area. Transfer and diversion of such native water has long been allowed under OSE policy and historically has not been considered to have a detrimental effect on water rights, the public welfare, or the conservation of water in New Mexico.
- Review of recent agreements reached between Albuquerque, MRGCD, Reclamation, FWS and others on river management indicates that a key issue is maintenance of a target flow of 105 cfs at Albuquerque's Central gage.
- The diversion of native water at the BDD, up to 2,525 ac-ft/yr or 3.49 cfs on average and not more than 4.25 cfs during the low flow months of September and October, should have no measurable effect on Rio Grande flows as gaged at Albuquerque (Central gage).
- Evaluation of USGS river flow records suggests that a flow of 300-325 cfs at Otowi (just above the BDD) should be more than adequate to allow maintenance the 105 cfs flow target at Albuquerque.
- A more detailed 'curtailment strategy' similar in approach to that agreed to by Albuquerque (see Attachment C) could conceivably be employed at the BDD. However, given the small amounts of native water involved and the recent agreements for river management reached among the FWS, Reclamation, Albuquerque, and MRGCD, it is doubtful that such an approach at the BDD would result in measurable benefits – the amounts of native water diverted at BDD are simply so small as to be 'lost in the wash.'
- We recommend that rather than a formal curtailment flow value being applied to operation of the BDD, that an agreement be developed along the following lines:

Based on consultation in the Spring of each year with FWS and other Rio Grande management agencies, if a determination is made that low flows at Otowi could approach 300-325 cfs in the coming months, and that native diversions at BDD could have a measurable effect on goals for maintaining flows below Cochiti Reservoir for the benefit of the minnow; then, the BDD proponents (BDD participating entities) will develop a mutually acceptable plan to mitigate such effects through modified operation of the BDD.

ATTACHMENT A

Schematic of Rio Grande System between Otowi and San Acacia, New Mexico



LINE DIAGRAM OF MIDDLE RIO GRANDE WATER OPERATION FACILITIES

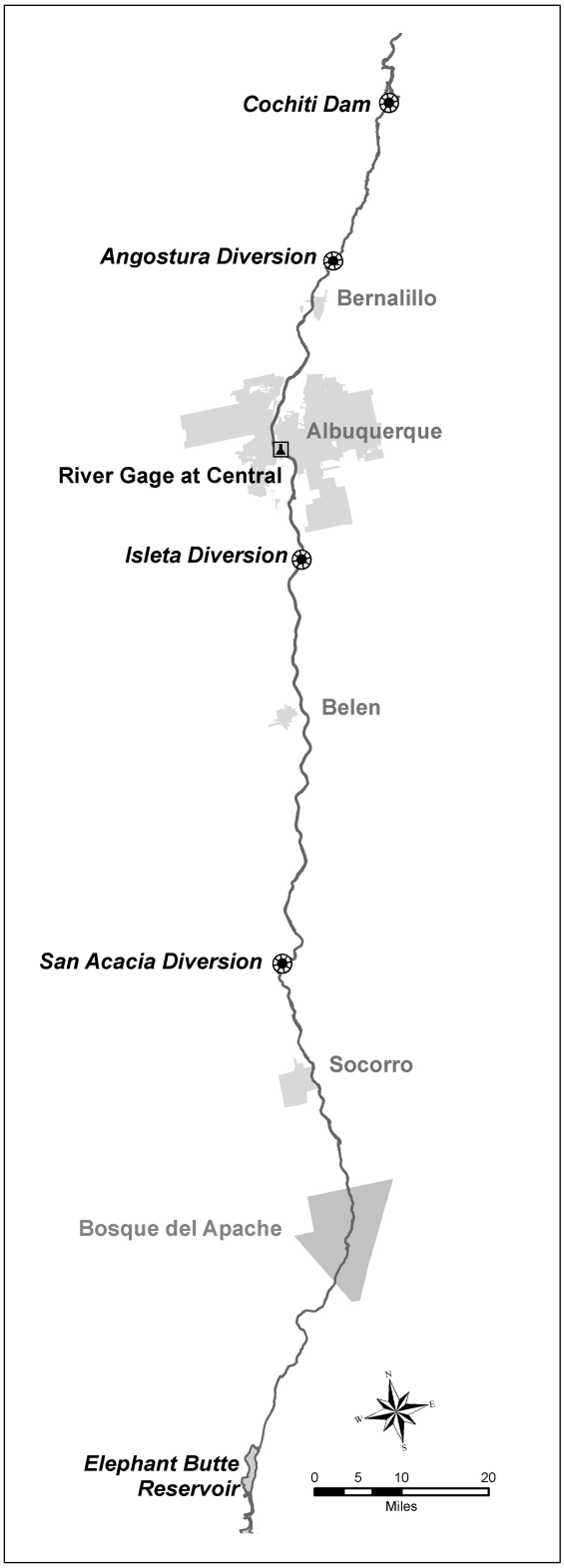
ATTACHMENT B

Summary of Agreements for Rio Grande Flow Management

Biological Opinion Provisions	**Relevant MRGCD Actions**
Reasonable and Prudent Alternative (RPA) A) Flow requirement: "Provide a one-time increase in flows (spawning spike) to cue spawning."	Managed irrigation diversions since 2002 to ensure a spawning spike in coordination with the Service, when sufficient water is available. *See* Rio Grande Silvery Minnow Population Monitoring Program Results from 2004 (April 15, 2005).
RPA E) Flow requirement (dry years): "Provide continuous flow throughout critical habitat from November 16 to June 15."	Manage irrigation diversions and return flows to ensure the required continuous flow. *See* Middle Rio Grande Endangered Species Collaborative Program, 2004 Annual Report ("Collaborative Program 2004 Report") at 12.
RPA F) Flow requirement (dry years): "Provide year-round continuous flow from Cochiti Dam to Isleta Dam with a minimum flow of 100 cfs at the Central Bridge gage."	Reduced irrigation diversions by 44% between 1996 and 2004 by increasing irrigation system efficiency. *See* Collaborative Program 2004 Report at 12.
RPA Q) "Improve gaging and real-time monitoring of water operations...including installation of gages (at)...all diversions, drains, returns, and main ditches."	Since 1996, MRGCD has installed gages on all diversions, all but 10 return flows, and all drains and main ditches. Other efficiency improvements, including automated diversion and main canal control gates, are ongoing. *See* Collaborative Program 2004 Report at 12.
RPA R) Complete fish passage (to allow upstream movement of silvery minnows) at San Acacia Diversion Dam by 2008, and at Isleta Diversion Dam by 2013.	MRGCD completed a study of natural barriers to upstream fish passage in 2004, and is working closely with Reclamation and the Corps of Engineers in ongoing studies of the feasibility of providing fish passage at San Acacia and Isleta Diversion Dams. *See* Bureau of Reclamation, Conceptual Design for San Acacia Fish Passage Structure (Sept. 2004).
RPA X) "Prevent encroachment of salt cedar on the existing channel and destabilize...point bars, banks, or sand bars."	Since 1996, MRGCD in coordination with the FWS and other members of the Collaborative Program, has assisted in the removal of salt cedar on more than 1,000 acres of bosque, and has participated in the Albuquerque Overbank Project to destabilize a point bar, river banks, and a sand bar. *See* MRGCD & University of New Mexico Department of Biology, "Introduction," Bosque Landscape Alteration Strategy ("BLAS") (June 2005). *See also* Bureau of Reclamation, Rio Grande Silvery Minnow Sanctuary Environmental Assessment – *Draft* ("Sanctuary EA") (July 6, 2005), Scope of Work: Albuquerque Reach Habitat Restoration Plan.

RPA AA) "Construct two new naturalized refugia breeding and rearing facilities for the captive propagation of the silvery minnow."	MRGCD, in partnership with Reclamation and the Service, provided the land and the water for the silvery minnow sanctuary planned to be built next to the Rio Grande south of Bridge Blvd. in Albuquerque. *See* BLAS. *See also* "Sanctuary EA;" Scope of Work: Albuquerque Reach Habitat Restoration Plan.
RPM 2.1) "MRGCD, in coordination with (the Service)...shall operate irrigation diversion structures (to)...minimize the entrainment of eggs and larvae into the irrigation system and allow for egg collection in the river when necessary."	In 2003 and 2004, MRGCD cooperated with the Service and Reclamation in studies of silvery minnow egg entrainment, helped install and maintain egg monitoring stations at the diversion dams, and has helped facilitate egg collection in the river. *See* Collaborative Program 2004 Report at 5.
RPM 3.1) "Continue to seek and release supplemental water from all available sources."	MRGCD has on several occasions since 1996 provided emergency loans of water to supplement flows for the silvery minnow.
CR 8) "Work with the...Collaborative Program...to develop a program for...increases in agricultural efficiencies."	Since 1996, MRGCD has used its own resources, along with more than $2 million in State and Federal funding, to improve agricultural irrigation efficiencies by installing new water gages, automating water control structures at diversions and in main canals, and canal lining. *See* Collaborative Program 2004 Report at 12.
CR 10) "Continue to work collaboratively to develop and implement a long-term plan to benefit the recovery of the silvery minnow and flycatcher."	MRGCD has been an active member of the silvery minnow and flycatcher recovery teams, and is actively involved in the ongoing update of the silvery minnow Recovery Plan. *See* Rio Grande Silvery Minnow (*Hybognathus amarus*), *Draft for Public Review*, June 5, 2003 version at p. ii.
CR 15) "Implement a strategy to improve water management/efficiency related to the irrigation system in coordination with an interagency advisory group."	MRGCD has since 1996, in coordination with Reclamation and the Collaborative Program, improved the efficiency of the irrigation system and water management by the installation of new equipment, automation of water controls, and the implementation of strict scheduling and rotation of water deliveries. *See* Collaborative Program 2004 Report at 12.
CR 16) "Encourage adaptive management of flows and conservation of water to benefit listed species."	MRGCD since 1996 has reduced diversions of water from the Rio Grande by 44%, through a series of technical and managerial improvements throughout the irrigation system. *See* Collaborative Program 2004 Report at 12.
CR 17) "Secure storage space and acquire water rights to create a permanent conservation pool to benefit endangered species."	MRGCD during the 2005 Session of the New Mexico Legislature supported the enactment of the Strategic Water Reserve, which Governor Richardson signed.

Summary of Key River Flow Requirements of the March 17, 2003 Biological Opinion (RPAs), and Actions of the Middle Rio Grande Conservancy District and Others to Comply With Those Requirements *July 21, 2005*



RPA A: Provide spawning spike MRGCD, Reclamation, Corps-managed releases from Cochiti and irrigation diversions since 2002 to ensure spike in river flow.

RPA E: Provide continuous flow Nov 16 – Jun 15 MRGCD, Reclamation, Corps-managed releases from upstream reservoirs, and irrigation diversions, to ensure continuous flow.

RPA F: In dry years provide 100 cfs flow at Central Ave. bridge gage MRGCD reduced irrigation diversions by 44% since 1996; combined with Reclamation & Corps reservoir management actions flow target has been met.

RPA AA: Construct new refugia MRGCD in cooperation with Reclamation and FWS providing land and water for new minnow sanctuary next to Rio Grande in Bernalillo County.,

RPA Q: Improve gaging of diversions, drains, returns, main ditches MRGCD installed gages on all diversions, drains, main canals, and 85% of return flows; automated water control gates at diversions and in main canals (program is ongoing w/ Fed, State, local funding)

RPA S, X: Restore minnow & flycatcher habitat MRGCD, in coordination with Service, built minnow habitat in river channel, plans additional habitat projects in 2006. Removed salt cedar to reduce fire threat to flycatcher habitat in the bosque (similar projects ongoing).

RPA R: Complete fish passage at San Acacia by 2008, at Isleta by 2013 MRGCD completed study of natural barriers to fish passage in 2004, now working closely with Reclamation & Corps in studies of feasibility of fish passage options at San Acacia and Isleta.

ATTACHMENT C

Summary of Albuquerque Surface Diversion Curtailment Plan

(from report, Hydrologic Effects of the Proposed City of Albuquerque Drinking Water Project on the Rio Grande and Rio Chama Systems, August 2002)

General Operating Plan for DWP Diversions

As has been the case since the inception of the SJC project in 1971, under the DWP the City will continue to work closely with those agencies having responsibility in managing the flows of the Rio Grande and Rio Chama. These include the USBR, the Corps, the OSE, and the MRGCD. More recently, because of the critical habitat designation for the Rio Grande silvery minnow, the U.S. Fish and Wildlife Service has become a more active player in flow management on the river. With the evolution of the multi-agency sponsored Upper Rio Grande Water Operations Model (URGWOM), and continued conference calls and meetings during critical times of year, the management of the SJC project and river flows and reservoirs on the Rio Chama and Rio Grande should become more efficient.

The City, in concert with the above agencies, will monitor snow pack, reservoir storage, seasonal weather forecasts, and other factors – particularly in the late-winter and early spring-periods leading up to the irrigation season (which begins in March). Preliminary decisions and action plans will be formulated as to how the City's SJC water will be managed, particularly in the case of likely low-flow or drought conditions, and whether or not surface diversions under the DWP will be curtailed or shut down entirely for several months in the coming year. As the critical warm weather irrigation season approaches (usually beginning in April or May), flow forecasts and river management decisions will be updated using URGWOM and specific plans formulated relative to the City's DWP release and diversion program for the coming year.

Objective and Conservative Basis for Evaluation of Hydrologic Effects Caused by DWP Diversions

To provide for an objective evaluation of hydrologic effects on the Rio Chama and Rio Grande through Albuquerque and down river, it is necessary to specify specific values of flow, release, and diversion under a hypothetical operation of the DWP. The release-diversion scenarios described below are intended for that purpose, and represent a worst-case condition for evaluation under the EIS or OSE Permit No. 4830. Deviations from the simplified release-diversion plan (which are fully anticipated under active management on the Rio Grande), will result in hydrologic effects less than those estimated in this document.

Diversion in Vicinity of Paseo del Norte Bridge

Figure 4-1 provides a simplified overview of how the DWP will be operated in most years assuming a diversion (either by surface or subsurface diversion) in the vicinity of Paseo del Norte Bridge. A constant release of about 66 cfs of City SJC water will be made from Abiquiu Reservoir. After incurring conveyance losses between Abiquiu and Albuquerque, approximately 65 cfs of SJC water will reach the diversion facilities. There a constant diversion of 130 cfs will occur throughout the year provided flows are more than or equal to a specified 'threshold flow' of 260 cfs just above the diversion point. The 130-cfs DWP diversion will include 65 cfs of SJC water and 65 cfs of Rio Grande water. The 65 cfs of SJC water will be consumptively used within the City's Water Service Area (WSA). The 65 cfs of Rio Grande water will, in effect, be returned to the river at the SWRP outfall near Rio Bravo.

Under the above plan, and assuming a diversion near Paseo del Norte (either surface or subsurface), there will be a reach of the Rio Grande between the point of diversion and point of return flow (about 14 miles) that will be depleted relative to native flows. (As

shown subsequently in Section 5, the No Action alternative has a similar effect in terms of depletion.) To ensure that DWP diversions do not dry up or otherwise adversely affect the riverine ecology between the diversion and return flow points, the City proposes to implement a curtailment strategy as described below.

For "normal" operation of the DWP under a constant release-diversion scenario, the flow at the diversion point (assumed here to be just north of the Paseo del Norte Bridge) must be 260 cfs or more based on the following:

- A diversion rate of 130 cfs comprised of 65 cfs of SJC water and 65 cfs of native water
- A fishway bypass flow of 50 cfs on the west side of the river
- A flow of 20 cfs at the outlet of the sluiceway on the east side of the river to provide for downstream movement of sediment and fish past the intake screens
- A minimum flow of 60 cfs over or through the adjustable crest-gate dam

Therefore, under "normal" operation, the minimum flow bypassing the DWP diversion will be 130 cfs (50 + 20 + 60 = 130 cfs), which is considered sufficient to prevent river drying in the Albuquerque reach, based on observations made in 2002.

Thus, the 260-cfs flow above the dam becomes a curtailment threshold intended to ensure that the Albuquerque reach (diversion to SWRP) will remain wet when the DWP is in operation. This curtailment threshold allows for potential depletions over the Albuquerque reach and ignores any inflows that would potentially vary during low-flow conditions.

Under "curtailment" operation, when native river flows at the diversion point fall below 195 cfs (total flow of 260 cfs with 65 cfs SJC in the river), the City will begin curtailing the quantity of the diversion by 1 cfs for each cfs of decrease in native flow, but will continue to release and divert the full 65 cfs of SJC water. As native flow continues to drop, DWP diversions will be reduced accordingly. When native flow reaches 130 cfs above the diversion, DWP diversions will cease entirely.

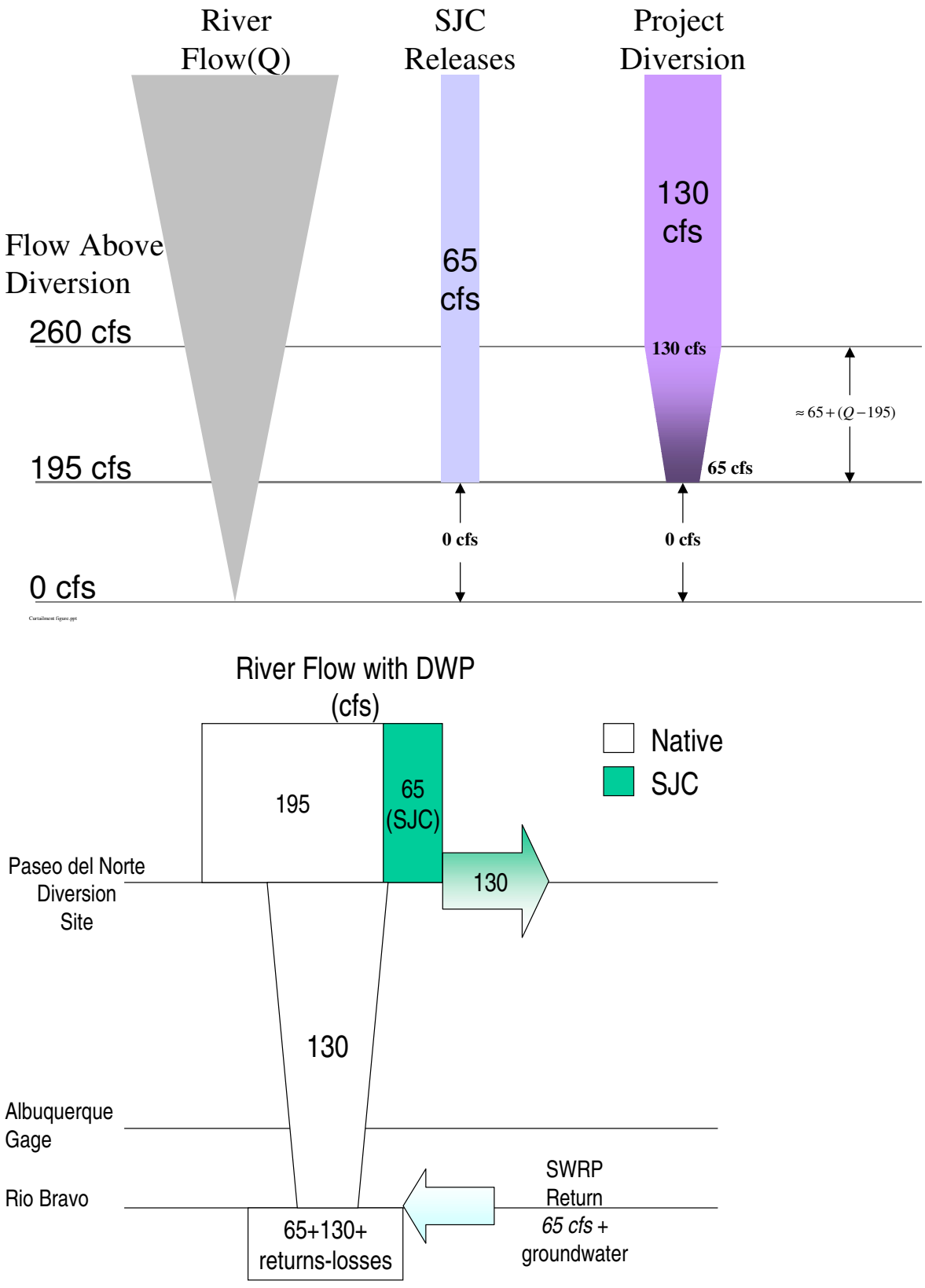


Figure 4-1. Summary of Release/Diversion Scenario for DWP and Relation to River Flows Assuming Diversion Near Paseo del Norte Bridge